<u>In the Specification</u>

On page 1, please delete the subtitle as follows:

~~Description~~

On page 1, please change the first paragraph as follows:

~~Filed of Invention~~ <u>Technical Field</u>

~~The invention~~ <u>This disclosure</u> concerns a method for detecting dynamic systems that can be characterized by system parameters being non-stationary in time, in particular a method for segmenting time series of measured quantities (variables) of dynamic systems and for identifying the system parameters (modes) that characterize the segments.

On page 4 bridging page 5, please replace the fourth paragraph as follows:

Object of the Invention

~~The object of the invention is~~ <u>It would be helpful</u> to provide improved methods for detecting the modes of dynamic systems with transient system parameters, by which the restrictions of conventional methods can be overcome, and which in particular allow, with practicable effort and high reliability, automatic segmentation and identification of time series with an enhanced number of details.

On page 5, please replace the first paragraph as follows:

Summary of the Invention

~~The invention~~ <u>Our disclosure</u> is based on the idea of comprehending transitions between different modes of a dynamic system as intermediate modes of the system that represent paired linear interpolations of the output and end modes of the transition. The observed dynamic systems tend to move gradually from one mode into another instead of switching abruptly between modes. ~~The invention aims at identifying~~ <u>We identify</u> such transitions between different modes in signals and the modes.

On page 5, please replace the second paragraph as follows:

Consequently, in a method for detecting the modes of dynamic systems, eg, after switched segmentation of a time series of at least one of the system variables x(t) of the system, drift segmentation is undertaken where, in each time segment in which the system transits from a first system mode s_i to a second system mode s_j, a succession of mixed prediction models g_i is

detected given by a linear, paired superimposition of the prediction models f_{ij} of the two system modes s_{ij}.

On page 5 bridging page 6, please replace the third paragraph as follows:

~~The subject of the invention is~~ We also provide a device for detecting a dynamic system with a large number of modes s_i, each with characteristic system parameters $\alpha(t)$. The device includes an arrangement for recording a time series of at least one of the system variables $x(t)$ of the system, an arrangement of switch segmentation for detecting a predetermined prediction model f_i for a system mode s_i in each time segment of a predetermined minimum length for the system variables $x(t)$, and an arrangement of drift segmentation with which a series of mixed prediction models g_i is detected in each time segment in which the system transits from a first system mode s_i to a second system mode s_j. The device ~~according to the invention~~ can also include an arrangement for setting interpolation and segmentation parameters, comparator circuits for processing the prediction errors of prediction models, arrangements of display and signaling, and an arrangement of storage. The device ~~according to the invention~~ can be a monitor for physiological data or physical or chemical process parameters.

On page 6, please replace the first paragraph as follows:

~~The invention provides~~ We further provide an instrument that has great potential for use in many medical, scientific and technical sectors. The segmentation of signals accompanied by identification of the fundamental dynamic response shows the way to new possibilities of prediction and control also in essentially non-stationary systems.

On page 6, please replace the second paragraph as follows:

Applications ~~of the invention~~ have shown that continuous transitions between system modes can be securely identified and that the fundamental dynamic responses can be described by the models with a precision that, in many cases, allows prediction of the system response. In many cases of non-stationary processes, ~~the invention enables~~ we enable models to be identified that are suitable for control of the processes, these not being possible without considering the transience.

On page 6 bridging page 7, please replace the third paragraph as follows:

Brief Description of the Drawings

~~Embodiments~~ Selected embodiments and further advantages ~~of the invention~~ are described in

what follows with reference to the attached drawings, which show:

Figs. 1a and b are graphs including curves illustrating a first segmentation step of the method ~~according to the invention~~,

Figs. 2a and b are graphs including curves illustrating a further segmentation step of the method ~~according to the invention~~,

Figs. 3a-d are graphs including curves of segmentation of blood regulating data after the method ~~according to the invention~~, and

Fig. 4   Curves of segmentation of EEG data with the method ~~according to the invention~~.

On page 7, please replace the first paragraph as follows:

Detailed Description of the Invention

~~To begin with, details of the invention will be explained with reference to~~ We first turn to Fig. 1 and 2 and then examples of practical application. It will be clear to the skilled person that the ~~invention~~ subject matter of this disclosure is not restricted to the application examples but may also be used in other areas as exemplified further below.

On page 7, please replace the second paragraph as follows:

(1)   Detection of drift transitions in non-stationary time series

~~According to the invention, non-stationary~~ Non-stationary time series are detected by a procedure in two steps: first suitable modeling and then so-called drift segmentation. The purpose of the modeling is to detect a predetermined prediction model for a system mode in each time segment of a predetermined minimum length for each system parameter. Here, a conventional switch segmentation is preferred as known, for example, from the publication by K. Pawelzik et al. in "Neural Computation", vol. 8, 1996, p 340 ff. Modeling is also possible by another, in relation to the derived system information for switch segmentation, equivalent procedure that is matched to a concrete application, for example for known pure modes or boundary conditions.

4

On page 11, please replace the first paragraph as follows:

Instead of the ~~socalled~~ so-called "hard competition" described here, where only one prediction model is optimized in a training step (ie "winner takes all"), it is also possible to alter the degree of competition as part of "soft competition" training, as described in the publication by K. Pawelzik et al.

On page 12, please replace the third paragraph as follows:

Two parameters a, b together with two network indexes i, j are characteristic of each mixed system mode. The number of mixed modes is limited to simplify the calculation effort. A finite number of values a(s) are defined with 0 < a(s) < 1 and b(s) = 1 − a(s). For further simplification, equal intervals are selected between the values a(s) according to

$$a_r = \frac{r}{R + 1} \qquad \text{with} \quad r = 1, \ldots, R \qquad (3)$$

R corresponds to the number of admissible intermediate modes and is also referred to as the resolution or graduation of the interpolation between the pure modes. The resolution R can assume any value, but it is selected sufficiently low as a function of application to achieve optimum system description (especially in heavily noise-corrupted operations) and practicable calculation times, especially in consideration of the switching rate given above. As discussed below in practical applications, it is possible for the resolution R to be selected manually by an operator or automatically by a control circuit as a function of an analysis result and comparison with a threshold value.

On page 14, please replace the first paragraph as follows:

The aim of the matching is the provision of an optimum sequence of networks or linear mixtures of them. A sequence is optimum when the ~~socalled~~ so-called energy or cost function C^* of the prediction is minimized. The cost function C^* is composed of the sum of the square-law errors of the prediction and the cost functions of the mode transitions of the sequence. Derivation of the cost function C^* between two points in time t_0 and t_{max} is inductive, assuming initially a start cost function according to

$$C_s(t_0) = \varepsilon_s(t_0) \tag{4}$$

where

$$\varepsilon_s(t) = \left(x_t - g_s \left(\vec{x}_{t-1} \right) \right)^2 \tag{5}$$

is the square-law error of the prediction of the pure or mixed modes g.

On page 17, please replace the first paragraph as follows:

~~According to the invention, time~~ Time series of physiological parameters that are characteristic of the set of red blood cells can be segmented as a function of application. The functionality of the segmentation is explained and exemplified below.

On page 18, please replace the third paragraph as follows:

(ii) Detecting sleep data

A further application ~~for the invention~~ is to be found in the analysis of physiological data that are characteristic of the sleeping and waking modes of humans. Time series of EEG data, for example, can be segmented as a basis for subsequent procedures to detect sleep disorders.

On page 19, please replace the third paragraph as follows:

(iii)   Further applications and advantages

Fig. 4a shows that detailed segmentations can be automatically produced by the method ~~according to the invention~~ that to date were only possible by observing complex features on the basis of broad experience and intuition. This advantage can be made use of not only in medicine but also in other areas where large amounts of data occur when describing complex dynamic systems. Such areas are physical, chemical and/or biological process engineering, geology, meteorology, climatology, speech detection.

On page 20, please replace the first paragraph as follows:

~~Methods according to the invention~~ The methods present the following advantages. The observed system can be highly dimensional (ten or more dimensions). The invention allows reduction of the complexity of such a system by observing lower dimensional modes and changing transitions between them. The use of prediction models for segmentation is invariant to changes in the

amplitude of detected signals.

On page 20, please replace the second paragraph as follows:

Use of the ~~invention~~ methods for prediction or control of a system works as follows. First, as described above, the actual state of the system is detected from preceding observation and knowledge of the current modes, this possibly being a mixture according to the result of drift segmentation. The actual state corresponds to a dynamic system f. Prediction means that the system f is applied to the momentary state x, resulting in the prediction for the state y that directly follows. Control means that the deviation from a setpoint state is determined from the actual state, and that an appropriate control strategy is derived from the deviation.

On page 20 bridging page 21, please replace the third paragraph as follows:

The advantage of prediction and control is that in complex systems (for example, detecting chemical reactions in a reactor), possibly only allowing measurement of a few variables, which themselves do not permit direct conclusions about the state of the system and any mixed states that exist because of ambiguities or system-immanent delays, detailed information about the system can nevertheless be derived. Thus, in the example with a chemical reaction, an optimum control strategy, comprising the dosing of certain coreactants, can be derived from detection, ~~according to the invention,~~ of the macroscopic, thermodynamic state variables for instance.